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NAS9-150

November 1, 1964

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September 16 to October 15, 1964

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ABSTRACT

Brief, illustrated narrative report of Apollo program progress for the period, highlighting accomplishments, milestone achievements, and a continuing summary of the program

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ILLUSTRATIONS

TABLES

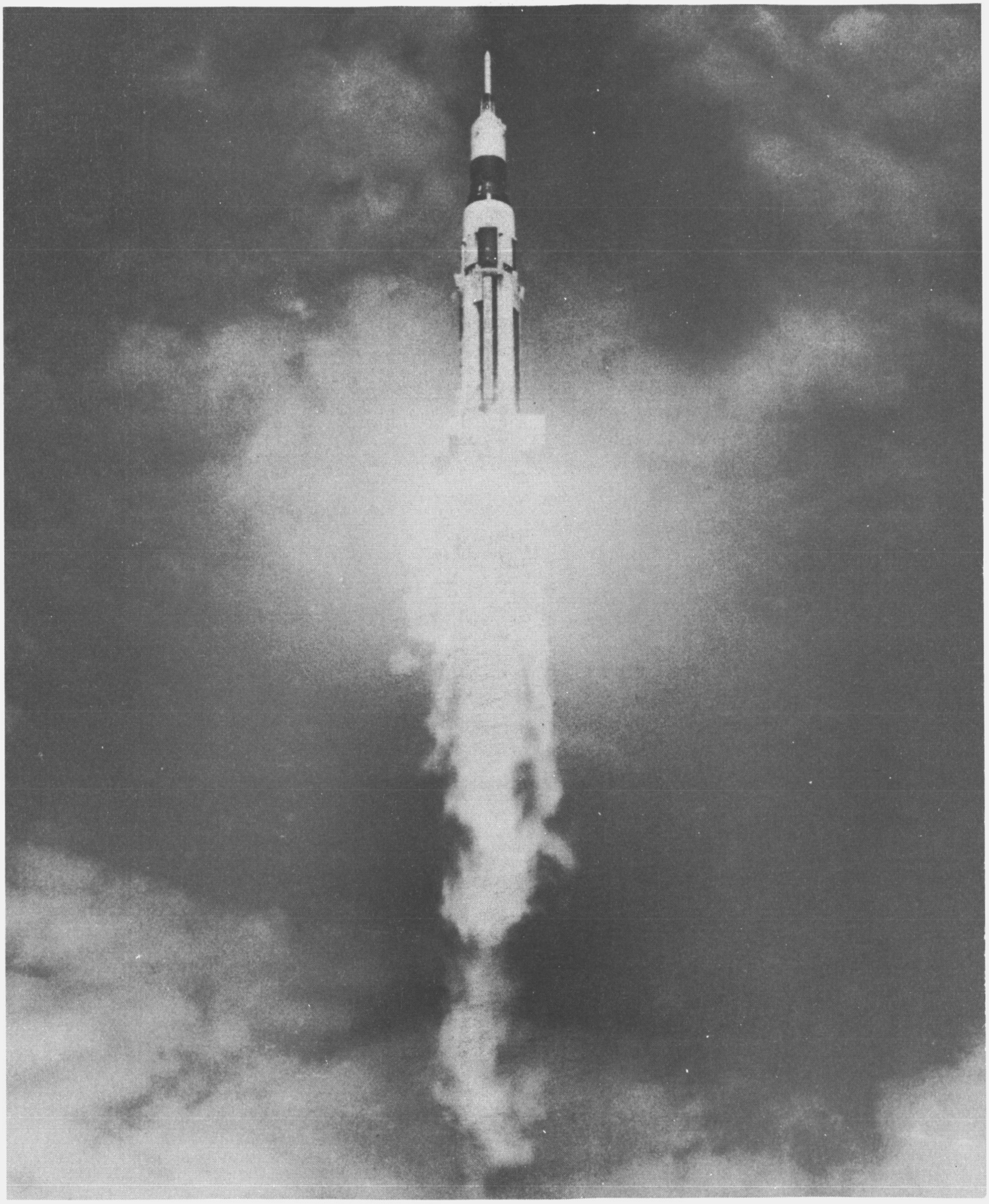

Figure 1. Boilerplate 15 Launch

PROGRAM MANAGEMENT

STATUS SUMMARY

Boilerplate 15 demonstrated the alternate mode of launch escape tower jettison and further verified the launch and exit environment in a successful flight on September 18. The SA-7 launch vehicle lifted from pad 37B at the Kennedy Space Center at 11:23 a.m. EST (see Figure 1). The boilerplate vehicle (command and service modules), the instrumentation unit, and the burned-out S-IV stage returned to the earth's atmosphere during the fifty-ninth orbit on September 22.

The initial hot firings of the test fixture F-2 were accomplished on September 22 and October 1, 13, and 15.

Details and initial analysis of the flight of boilerplate 15 and the hot firings of the propulsion system development facility are to be found in the Development and Operations sections of this report.

The command module, hard boost cover, and certain items of GSE for boilerplate 23 were shipped to the White Sands missile range on September 18. (The service module had been shipped on September 15.) The launch escape tower and canard assemblies were shipped to WSMR during the report period. Installation of the earth landing subsystem (ELS) was started on September 29.

Stacking and alignment operations were completed on the command and service modules of boilerplate 27. The command module was shipped to the Manned Spacecraft Center (MSC), Houston, on October 1. The service module was shipped October 5.

Vehicle parachute drop 13, using boilerplate 19, was conducted on October 2 at El Centro. This drop was the second of two constraint drops on the launch of boilerplate 23 at White Sands. The double-drogue, three-parachute drop was stable, and the vehicle showed no visible damage after impact.

Tube brazing and welding operations for the electrical power (EPS), cryogenic, and service propulsion (SPS) subsystems for spacecraft 001 were completed on October 13.

Initial checkout was completed on the electrical power subsystem and environmental control subsystem (ECS) for boilerplate 14 during the report period. Initial checkout was started on the communication and instrumentation equipment of the boilerplate. The checkouts are being conducted under the revised test plan that has scheduled the start of the initial acceptance checkout (ACE-SC) of the installed subsystems during the next period.

Installation of the blast barrier for the service module of boilerplate 22 was completed on October 15.

Grumman and S&ID have formed a coordination steering committee supported by ad hoc working groups to handle interfaces between Grumman and S&ID. The committee and working groups will operate in accordance with procedures under the existing NASA-S&ID-Grumman memorandum of understanding. The committee will be concerned only with S&ID-Grumman coordination problems.

SITE ACTIVATION AND LOGISTICS

Supply and Test Site Support

A new policy concerning spares with the major subcontractors is being implemented in coordination with the S&ID Material department. A detailed schedule has been developed for amendment of appropriate purchase orders.

Project Recomp, to realign all existing spares releases to conform to the NASA sparing policy, has been completed. A reduction of approximately 4000 line items, in varying quantities, was realized.

Logistics Engineering and Support

A meeting was held with NASA personnel on September 30 to review the Apollo Mission Simulator Instructor Handbook. Complete technical agreement was reached between NASA and S&ID on scope and format. The Apollo Part-Task Trainer Instructor Handbook is being prepared for a similar review in November.

The two-month series of spacecraft systems briefings for NASA personnel began October 12 at MSC, Houston.

The October issue of the GSE Planning and Requirements List (SID 62-417) reflects the decisions of "Operation Squeeze" and incorporates the results of an extensive program to verify and update all GSE planning and requirements information.

Inputs to the Block II command and service module subsystems model specifications were prepared for the purpose of including significant maintainability design requirements in the model specifications for the 20 major subsystems. The inputs cover design considerations to provide for serviceability and accessibility during scheduled and unscheduled maintenance.

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DEVELOPMENT

SYSTEM DYNAMICS

Aerodynamics

Boilerplate 15 achieved the aerodynamic test objectives assigned to this launch-environment vehicle. The objectives were to determine the atmospheric pressure environment for verification of aerodynamic load design criteria, and to demonstrate the alternate jettison mode of the launch escape subsystem using the launch escape and pitch control motors.

Preliminary preflight analyses of the boilerplate 23 mission were completed. Center of gravity and thrust vector alignment requirements were computed for use in final weight and balance operations. Final pre-flight analyses will be completed upon receipt of the Little Joe II trajectory data from NASA-MSC.

Inspection of flight hardware revealed that some modification of instrumentation is required to assure that surface pressures of the boost cover will be accurately sensed during flight. Tests were completed to establish criteria for the revised installation, and the required design changes were started.

Earth Landing Subsystem (ELS)

The canard assembly for boilerplate 23 was completed and shipped to WSMR for final test preparations.

All ELS constraints for boilerplate 23 were satisfied with the successful completion of drop test 13 using boilerplate 19. The test was made at El Centro with drogue initiation programmed at the dynamic pressure anticipated for boilerplate 23.

Boilerplate 28 is being readied for the first water-primary impact tests. Side wall modifications, ballast installations, sealing of crew compartment, and air-leak tests were completed. Instrumentation wiring was installed, and final hookup is nearly complete.

[redacted]

Initial design of a postlanding sequence controller for a flotation subsystem was completed. Parts are being procured for the fabrication of a development breadboard to use in conjunction with boilerplate 2 in the impact and flotation subsystem tests scheduled for January 1965. The prototype of this sequencer will be used on unmanned Apollo vehicles.

MISSION DESIGN

The effects of the deletion of the entry monitor subsystem (EMS) from Block I manned vehicles were examined. Minimum display requirements, acceptable control modes, and mission constraints were investigated, with the following conclusions:

1. Without the EMS, the roll attitude display represents the minimum display requirement that will assure safe entry trajectories (see Table 1).

2. The addition to the roll attitude display of individual acceleration, acceleration rate, and velocity displays would produce no significant improvement.

3. Complete test objectives cannot be achieved in the closed-loop mode without the EMS.

4. Deletion of the EMS imposes subsystem operational constraints and reduces mission design flexibility (see Table 2).

Table 1 shows the acceptable trajectory control modes for manned flight with the roll attitude display and no EMS.

Table 2 shows the preentry limitations imposed on mission design for manned flight with the roll attitude display but no EMS. A comparative summary of mission design parameters, with and without the EMS, is given. The design corridor used in Table 2 is based on standard models. When subsystem deviations, uncertainties, and contingencies are considered, the allowable entry velocity is substantially reduced by the deletion of the EMS. Missions will be restricted to low-altitude orbits with little design flexibility, and complete closed-loop entry test objectives must be delayed until Block II development flights. This results in less over-all design confidence in entry subsystems for the lunar mission; and at least one Block II flight with Block I constraints must be provided.

An analysis of critical design requirements is being made for the service propulsion subsystem (SPS). This study is being made in support of the Phase II program of the Apollo mission planning task force (AMPTF).

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Table 1. Acceptable Entry Control Modes

Initial Entry Velocity	Acceptable Control Modes	Control Attitude Constraints	Ranging Capabilities
Under 26,000 feet per second	1. Primary guidance 2. Constant bank attitude	Absolute angle of roll less than 90 degrees	Limited closed-loop ranging capability
	3. Ballistic	Constant roll rate	
Over 26,000 feet per second	1. Constant bank attitude	Absolute angle of roll less than 90 degrees	No closed-loop ranging capability
	2. Ballistic	Constant roll rate	

Table 2. Entry Corridors With and Without EMS*

Initial Entry Velocity (fps)	Maximum Design Corridor** (deg) With EMS	Maximum Design Corridor** (deg) Without EMS	Percentage of Corridor Reduction	Representative Orbits, Maximum Apogee Altitude, Retro Maneuver (NM)
26,000	6.0	1.9	68	450
28,000	4.6	0.9	80	2000
30,000	3.5	0.2	94	4000
36,000	2.4			

*Entry interface at 400,000 feet
**Allowable difference in initial entry flight path angles

[redacted]

A report is being prepared showing the mission-related functional requirements of the SPS for both nominal and contingency situations, and indicating the ability of the present SPS to perform these functions. A preliminary review of this report was conducted on September 30 by the AMPTF directors; final release of the report is scheduled for early November. The review disclosed no serious discrepancies between SPS functions and SPS ability to perform them. The following three items received special attention:

1. Variations in thrust level (within specification tolerances) that can occur during SPS operation

2. Present propellant tank oversizing beyond that which is necessary to perform the NASA design ΔV budget (Tank volume is provided for approximately 10 percent additional propellant.)

3. Inability of the SPS to make some small ΔV firings due to the finite minimum impulse of the subsystem (Minimum ΔV requirements, however, have not been established.)

A study was made of the effects on high-gain communications resulting from the passive temperature control of the reaction control subsystem

Table 3. Loss of High-Gain Communications Line-of-Sight

Mission Phase	Number of Acquisitions	Percentage of Phase Time Without Communications	Average Interval Without Communications* (min)	Longest Interval Without Communications (min)	Total Time Lost From Communications* (min)
Translunar	62	21**	14.0**	18.0**	868.0**
Lunar orbit	90	46** Including time behind moon	2.2** Earth side of moon	46.0** Back side of moon	158.0**
Transearth	76	19**	14.0**	18.0**	1064.0**

*Due to vehicle rotation on X-axis

**Data reflect only line-of-sight availability; reacquisition time will increase the duration of time without communications as much as 5 minutes per acquisition.

(RCS) in the service module. The present method of achieving this passive temperature control requires the rotation of the command and service modules about the X-axis with this axis maintained normal to the vehicle-sun line. In most cases, this results in an angular displacement from the vehicle-earth line. The rate of vehicle rotation about its X-axis was assumed to be one revolution per hour during transearth and translunar phases, and six revolutions per hour during lunar orbit. The rotation of the spacecraft, when the X-axis is displaced from the vehicle-earth line, will result in communication null periods. An antenna pattern hole will exist because the spacecraft will be interposed between antenna and earth, thus blocking transmission to earth. Table 3 shows the effect on high-gain communication capabilities caused by this rotation during AMPTF initial reference missions.

CREW SYSTEMS

All detail parts, including optics, for three prototype models of the collimated optical docking aid were received and are being assembled (see Figure 2). Completion is scheduled for mid-October. One unit will be delivered to NASA-Langley Research Center for use in full-scale docking studies; the other two units will be used for S&ID engineering evaluation. NASA indicated that this device may also be used as a docking aid on the lunar excursion module. Two mock-ups of the prototype of this optical sighting device were completed, one for use at NASA-Langley to determine compatibility with the lunar excursion module and one for engineering evaluation use at S&ID.

Apollo zero-g flight tests were conducted jointly by S&ID, MIT, and NASA at Wright-Patterson AFB September 21 to 24; results are being evaluated. Four astronauts participated in the following zero-g tests aboard a KC-135 aircraft:

1. The guidance and navigation (G&N) restraint subsystem and space suit interface was studied. Sextant alignment was simulated using operable hand controllers that were mechanized for a star- and landmark-alignment task. Both Block I and Block II hand control panels for the lower equipment bay were evaluated. The G&N station restraint subsystems were functionally tested.

2. An updated crew couch restraint subsystem was tested for ease of attachment and adjustment. The center couch was evaluated for ease of adjustment from the G&N position to the boost and entry position.

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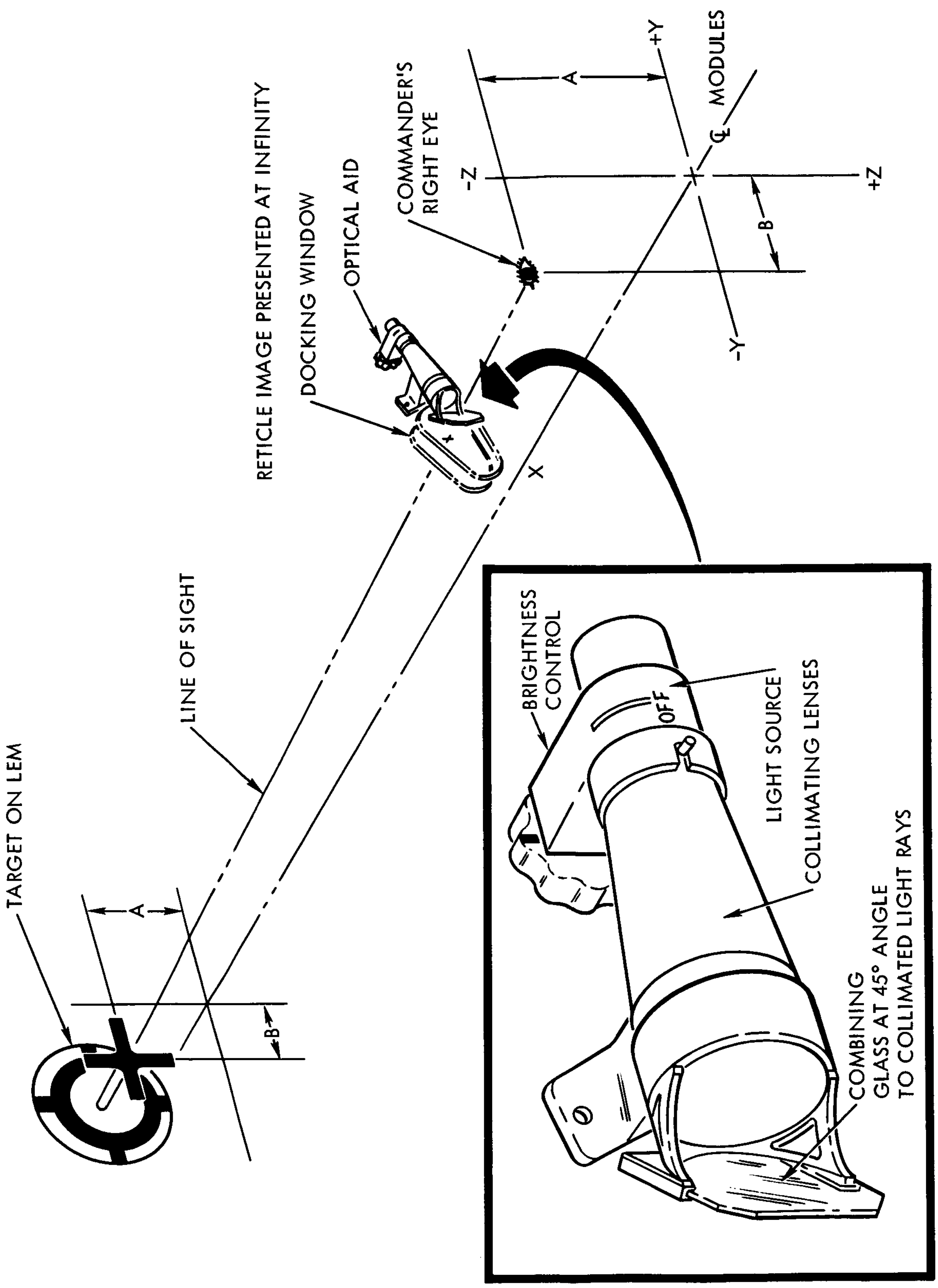

Figure 2. Command Module Optical Alignment Sighting Assembly and Lunar Excursion Module Target

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3. Control switches and circuit breakers for the main display panel were operated with different preloads to determine optimum loading.

4. A mock-up of one concept of a sleep station was tested to determine ease of ingress and egress and restraint capabilities.

5. Two space suits (Apollo 024 and Gemini 2C) were compared for mobility under simulated lunar gravity conditions. The latest configuration of the portable life-support subsystem was charged with liquid oxygen and provided space suit pressurization and breathing oxygen.

STRUCTURAL DYNAMICS

The modal, vibration, and acoustic tests for ground spacecraft 006 and 007 are being reduced in scope. Likewise, the modal and vibration transmissibility study is being decreased, and the environmental vibration test on spacecraft 006, using "live" subsystems, has been cancelled. As a result of these changes, initial spacecraft flights will serve as development and evaluation tests rather than demonstration flights.

Aeroelastic evaluations of the canard subsystem show good safety margins for flutter and divergence under all flight conditions investigated thus far.

A land impact analysis was made using the new criteria for two-parachute landing of 35-fps vertical velocity. Results show that the allowable accelerations for emergency impact will be exceeded for the crew if the present couch strut subsystem is used. Additional calculations will be made to resolve this problem, assuming different honeycomb cores in the struts.

Results were obtained from the recent impact test program conducted at NASA-Langley Research Center using a fourth-scale model. These data, plus results of previous S&ID tests using a tenth-scale model, and calculated data, were used to develop the boilerplate 28 water-impact test program. The complete impact test plan, including full-scale drop conditions, instrumentation, and testing of strut and couch was reviewed jointly by S&ID and NASA on October 6 and 7. Drop tests of boilerplate 28 are scheduled to begin during the next report period.

STRUCTURES

An aluminum alloy specimen (sulphuric-acid anodized and dry-film lubricated) successfully completed a sliding friction test under severe load conditions in an ultrahigh vacuum (10^{-9} Torr) at room temperature.

This is the first such test using aluminum in the Apollo space bearing program. A total of 35,418 cycles were accumulated in which the kinetic coefficient of friction averaged 0.008. This value is very low for sliding oscillatory friction and equals the average oil lubrication values of antifriction bearings.

33 shaped charges have been detonated for calibration and design verification in the meteoroid test program. The design characteristics required to produce a well formed and discrete jet are being evolved as a result of the tests. The charges are supplied by Picatinney Arsenal for the tests being conducted at the Defense Research Laboratory of General Motors Corporation.

NAA, Los Angeles, completed the investigation of the failed explosive bolt used in boilerplate 15 between the launch escape tower and the command module. Four such bolts are used, and one of these suffered a complete fracture while the vehicle was stacked at Cape Kennedy prior to launch. Fractographic and metallographic studies substantiated S&ID's preliminary conclusion that stress corrosion did not contribute to the failure.

Cutter assemblies for the dual-drogue disconnect were procured from Explosive Technology. Two cutter assemblies were used on each of four test blades made of 4340 steel 0.110 inches thick to satisfy constraints for a boilerplate 19 drop test. A new 6Al-4V titanium blade will be development-tested as a result of successful preliminary tests. Plans are also being made to test an Inconel 718 blade.

The first two sectors of the service module aft heat shield cover, completed by Electroform, were evaluated by S&ID and were found to conform to design. The subcontractor will deliver two sectors weekly to complete their contract. This thin metal cover holds the SPS engine heat shield insulation in place.

GUIDANCE AND CONTROL

The boilerplate 14 stabilization and control subsystem (SCS) was delivered by Honeywell. Inspection was completed, and checkout of wiring is in progress. Power-on tests are scheduled to begin about mid-October.

NASA astronauts, wearing pressurized suits, agreed on the optimum position of the Block I hand controller to allow full movement. The position of the holding fixture is being revised accordingly for submittal in a proposal to NASA. Figure 3 shows the present hand controller position for Block I vehicles and a proposed position.

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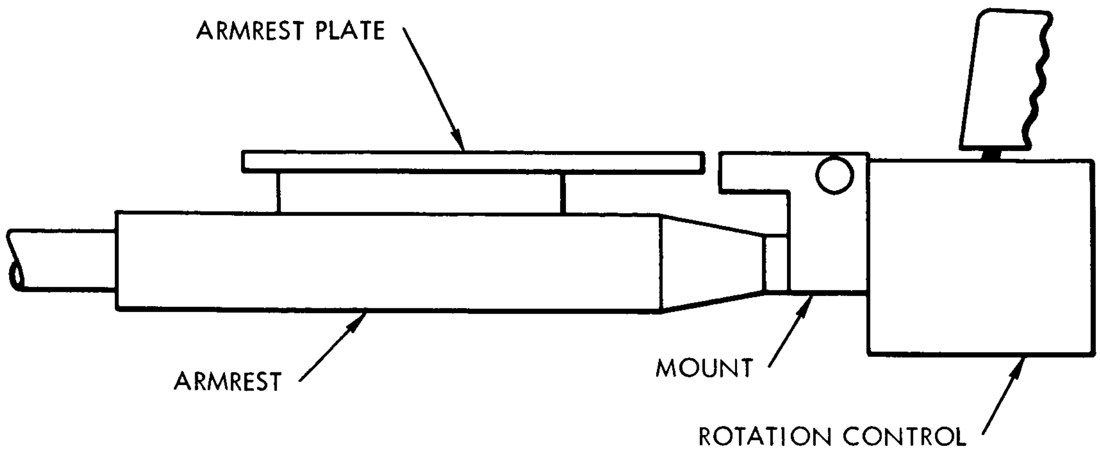
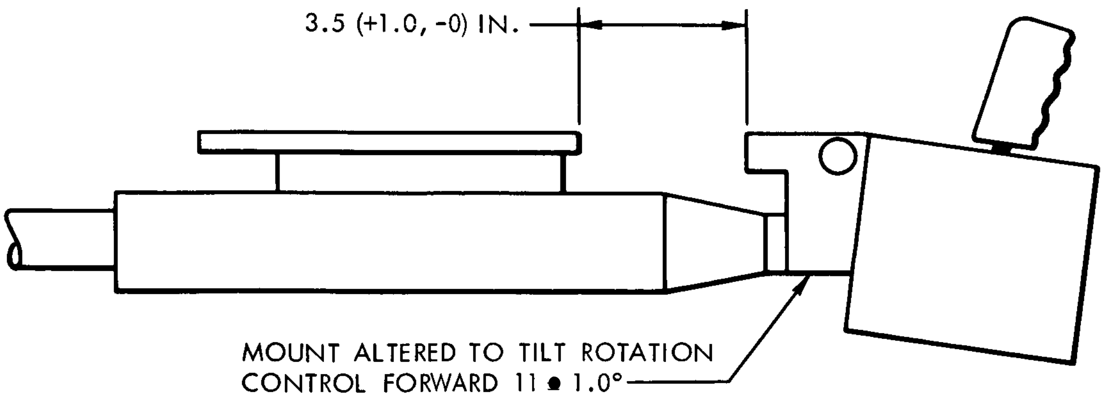


PRESENT BLOCK I CONFIGURATION



PROPOSED BLOCK I CONFIGURATION

Figure 3. Present and Proposed Hand Controller Position for Block I Vehicles

[redacted]

An engineering breadboard of the plotter display and associated driver equipment for the entry monitor subsystem is being assembled. Fabrication is 50 percent complete, and delivery to S&ID is scheduled for mid-October. The breadboard will be connected to computers for use in determining the optimum size of the display window and for evaluating plotter scale factors.

A revised simulation program was presented by S&ID to NASA on September 30 and October 1. The plan is based on an indefinite delay in the simulator 1 complex program and an expanded evaluator program instead. S&ID proposed the incorporation in the evaluator complex of a combined subsystem dynamic verifier, a limited subsystem to furnish external visual cues, and a flight table. The table would also be used to support guidance and control laboratory investigations.

Evaluation of manual reorientation of the command module following simulated high-altitude LES abort was conducted on evaluator 1 using internal instrumentation. A total of 80 training runs, 40 familiarization runs, and 480 production runs were completed with subjects in the loop wearing pressurized and vented Gemini suits. The preliminary results of the study indicated the following:

1. The minimum abort altitude at which a manual orientation can be made is 100,000 feet for a Saturn IB trajectory and 110,000 feet for a Saturn V trajectory.

2. The monitor mode proved to be the most favorable for manual orientation from the standpoint of failure detection and correction.

3. The criticalness of SCS failures after rate stabilization is comparable to those of a normal entry.

4. No appreciable degradation in subject performance was noted in the vented pressure suit condition; however, severe vision and reach restrictions were experienced by the subjects wearing pressurized suits. These restrictions resulted in a lowering of subject performance, although none of the 31 runs in which random SCS failures were inserted would have resulted in a loss of the vehicle.

TELECOMMUNICATIONS

System tests were completed during this reporting period on the television bench maintenance equipment (BME). The C-band BME checkout will resume upon correction of a defective signal generator. The checkout of the up-data link BME is in progress.

The HF antenna specification may be revised to incorporate a single monopole base-fed antenna. A study is in progress and should be completed during the latter half of October.

Bid proposals on the 2-kmc high-gain antennas are due the last of October; evaluation should be completed during the latter half of November.

The Apollo telecommunications engineering evaluation (ATEE) spacecraft console was shipped to NASA-MSC for use in checking compatibility of the spacecraft subsystems and the manned spaceflight network at Houston. Two S&ID employees will participate in the NASA-MSC communications evaluation program.

A revised layout of the Block II communications control panel was completed. Continuous interphone capability is being added as the result of a request for change generated at the Block II design engineering inspection (DEI) September 29, 30, and October 1. In addition, studies will be conducted on antenna configuration and antenna switching as requested at the DEI.

Finalization of measurement requirements for spacecraft 009 and 011 resulted in minor changes; a major reduction in spacecraft 012 measurement requirements was achieved. Measurement requirements are now frozen for spacecraft 009, 011, 012, and all subsequent Block I vehicles except the heat shield measurements for spacecraft 017 and 020.

94 structural integrity measurements were added for the service module and adapter of spacecraft 009. A modification kit will provide a separate telemetry subsystem in the adapter for these measurements.

ENVIRONMENT CONTROL

A humidity sensor will be added to the return ducting of each of the three space suits. The transducers that NASA proposes to furnish, however, are of a greater diameter than the ducting (0.953 inches versus 0.937 inches), and the operating wattage required exceeds the maximum available for each transducer (5.667 watts versus 2.0 watts). In order to avoid duct contouring and in order to stay within power budgets, S&ID is coordinating effort with NASA to reduce transducer size and wattage requirements.

AiResearch has initiated Group I qualification testing of 26 environmental control subsystem (ECS) components, 12 of which have completed the tests. Deliveries of production ECS package units for the breadboard and spacecraft are scheduled as follows:

Use	Date
Breadboard	October 23
Spacecraft 006	October 28
Spacecraft 009	December 21
Spacecraft 008	January 11
Spacecraft 011	February 8
Spacecraft 012	March 8

Technical problems associated with the incorporation of the selective stagnation concept in Block II space radiators were outlined by S&ID at a meeting with NASA-MSC. Difficulties considered included the following:

1. Sensitivity to unknown factors such as edge effects and local surface properties

2. Possible requirements for a complicated control of fluid distribution and the required heat rejection

3. Increased analytical computer time required by the proposed NASA plan

Better definition of electrical heat load distribution, with and without coldplates, is being obtained by using data derived from analyses of command module transient coldsoak and ablator bondline temperatures. These more accurate electrical heat loads can be used to improve computer simulation studies of possible condensation problems in the Block I command module.

Plans are being completed for compatibility tests of heat shield and instrumentation at Ames Research Center. Model instrumentation and test environments are described for each test run. Analyses of the heating and shear stresses were completed, and heating rates were predicted to match selected body points of spacecraft 009 and 011. Shear values obtained in the model tests will be two to three times greater than actual flight values in five of the seven test environments and will closely match the values in the remaining two.

Preliminary thermal analyses of the edge conditions for the ECS radiator panel during maximum solar incidence indicate a service module

[redacted]

skin temperature range of 140 F to 180 F within 18 inches of the radiator panels. For a coldsoak condition, these temperatures are in a range of -140 F to -50 F. For a radial beam structure remote from the panels, minimum and maximum temperatures are respectively -140 F and 150 F.

The maximum predicted temperature is 170 F for the ordnance device of the command module drogue chute at the time of deployment. This is considerably below the specification temperature limit of 250 F.

ELECTRICAL POWER

The hydrogen and oxygen tanks for spacecraft 006 were received from Beech Aircraft, and the associated valves are scheduled for shipment in late October. Delivery of these components completes the hardware requirements for the cryogenic gas storage subsystem (CGSS) to support spacecraft 006 schedules.

Burst test of the fourth oxygen pressure vessel successfully completed the qualification test program for the Inconel 718 pressure vessels. This vessel burst at 1922 psig compared to 1873 psig for the third vessel. (Predicted burst pressure was 1819 psig.) Each vessel was hydrostatically ruptured at room temperature, and investigations of each vessel disclosed shear failure of the material, indicating good ductility. Both the Inconel 718 (oxygen) and the titanium 5Al-2.5 Sn (hydrogen) pressure vessels are now fully qualified.

For the first time, two fuel cell power plants were successfully operated in parallel in a simulated space vacuum at S&ID. Current transients of fuel cell output during load switching were studied, and the ability of each power plant to share a common load was demonstrated. Three fuel cell power plants will undergo a similar parallel load test during the next report period.

An adequate safety margin will be assured for entry and postlanding electrical requirements for spacecraft 012 and subsequent Block I spacecraft by replacing the three present 25-ampere-hour entry batteries with three 40-ampere-hour batteries.

Qualification testing of the 25-ampere-hour entry and postlanding battery should be completed in mid-October, and the final test report should be released in early November. The 25-ampere-hour battery will be used on earlier Block I vehicles. At the conclusion of the 60-day charged stand test, 27.69 ampere-hours of usable capacity remained in the test battery. This amounted to a true loss of approximately 12.75 percent. The tests show that the battery exceeds design requirements which allow a 45 percent true loss from a full charge of 35 ampere-hours down to about 20 ampere-hours of usable capacity at the end of a 60-day charged stand.

A study reveals that main dc bus voltage ripple may be as high as 1 volt, peak-to-peak, over a frequency range of 20 to 30,000 cps. This value is greater than the 0.250-volt limit established by NASA. A request to increase the NASA limit is being initiated.

The empirical equations relating fuel cell voltage, power, electrolyte concentration, and temperature were incorporated into a computer program to analyze fuel cell steady-state operations. Results were compared to the curves of fuel cell performance characteristics recently furnished by Pratt & Whitney. Agreement between the analytical results and the Pratt & Whitney curves was excellent for the basic functions and the first derivatives of these functions. However, the second derivatives of the functions for electrolyte concentration and temperature indicate poor agreement. Better correlation should be possible as soon as data requested from Pratt & Whitney on bypass valve flow versus temperature are available and can be incorporated in the computer analysis program.

Preliminary design proof tests of the caution and warning detection unit were completed. The results indicate satisfactory performance to electromagnetic interference requirements.

A new caution and warning subsystem requirement was added, calling for warning of SCS reaction jet driver failure. Design is in process on a time comparator to warn of excessive reaction jet burning time.

As a result of requirements established at the cabin lighting DEI on September 3, the floodlighting design was reviewed, and design was started on dimming circuits for the integrally lighted instruments and master caution indicator matrices of the main display console. The review of floodlighting requirements indicated a need for additional units and redesign of existing units to provide the necessary illumination. Designs are in progress to meet the DEI requirements.

PROPULSION

Service Propulsion Subsystem (SPS)

The first hot firing of the SPS engine on the F-2 test fixture at White Sands (Figure 4) resulted in an unstable start transient caused by a main engine valve malfunction. The engine was shut down automatically by the vibration safety cutoff subsystem. The second test was successful, resulting in a 10-second hot firing with satisfactory engine performance. The oxidizer inlet pressure, however, was found to be below nominal.

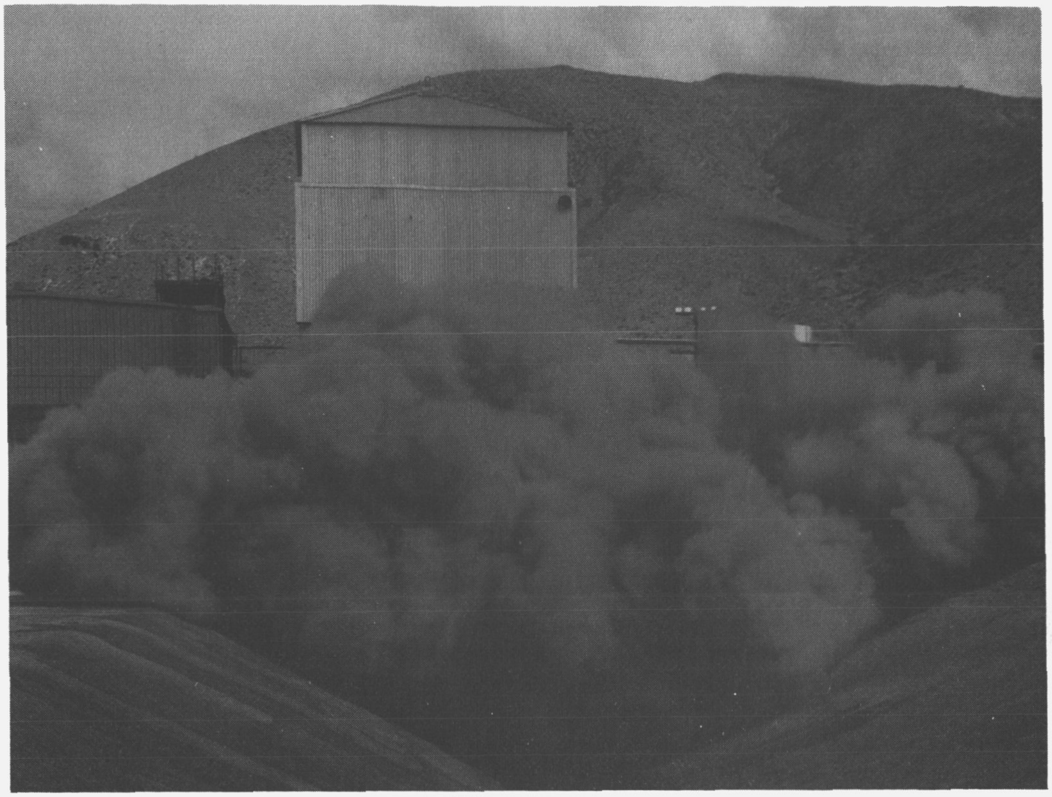


Figure 4. First Hot Firing of SPS Engine, Test Fixture F-2

The dynamic stability program continued with 85 injector firings. Table 4 lists all firings conducted during this report period.

The propellant utilization and gauging subsystem will be deleted from spacecraft 009, because the mission of this vehicle is not suitable for obtaining adequate data from this equipment.

Reaction Control Subsystem (RCS)

Lear-Siegler completed the off-limits test program of the test point disconnect for the command and service module RCS, and 150 of these units were shipped to S&ID.

Qualification tests were completed successfully on the helium pressure vessel for the command and service module RCS, and off-limit tests will follow immediately.

Table 4. Apollo SPS Engine Test Program

Serial No.	Pattern Type	Type of Evaluation	Ablative Chamber No. of Firings	Ablative Chamber Time (sec)	Steel Chamber No. of Firings	Steel Chamber Time (sec)	Results
AFF-60	POUL-31-37	Acceptance test	1	31			Two streaks
AFF-68	POUL-31-37	Acceptance test	1	31			Excessive streaking
AFF-35	POUL-31-37	Acceptance test	1	31	6	28	Minor streaks
AFF-64	POUL-31-37	Acceptance test	1	31	5	30	Satisfactory
0009 (5-4-2)	POUL-41-36	Mission duty cycle	27	731			Intermittent popping
0004 (5-4-2)	POUL-31-50	Mission duty cycle	3	53			Rough operation, popping, and streaking
		C*			2	13	Satisfactory
		Pulse			1	6	156.9 grain pulse
0012 (5-4-4)	POUL-41-29	C*			5	28	Initial firing in "E" test area
0010 (5-4-4)	POUL-41-36	C*			2	11	Satisfactory
		Pulse			1	6	156.9 grain pulse
0013 (5-4-2)	POUL-41-26	C* and pulse			8	42	Satisfactory recovery
		Earth orbit mission	36	770			Satisfactory

C* = characteristic exhaust velocity

Design verification tests were completed on the Pyrodyne burst disc for the command module RCS. An improved design permitting static sealing and lower installation torque will be incroporated in qualification test units.

Rocketdyne completed acceptance testing of two of the command module RCS engines that will be used in the prequalification test program. In addition, one of these engines successfully completed a critical vibration test simulating a high-q abort.

The Phase II breadboard of the command module RCS was successfully hot-fired for the first time. The Phase II breadboard consists of an assembly of nonqualified spacecraft hardware components. After successful system activation, each of the six system "A" engines was fired for calibration. Test data are being analyzed.

Launch Escape Subsystem (LES)

Failure of the interstage spot welds during the third qualification test of the tower jettison motor at Thiokol on September 9 resulted in an immediate investigation. The boilerplate 15 interstage was strengthened by two rings of bolts; a final modification employing 338 rivets was incorporated on the boilerplate 23 interstage; and all other interstages on hand are being modified in the same way.

All interstages, including those modified, will be structurally tested in a static load fixture now being constructed. The first of these modified interstages will be proof tested and then retrofitted into boilerplates 16, 22, and 26, and spare motors for White Sands and Cape Kennedy. The inert motor for boilerplate 27 will not require retrofit.

Because of damage to test stand components as a result of the interstage failure, qualification testing of tower jettison motors is not expected to resume until November, with completion rescheduled for late March 1965. Delivery schedules of fully qualified motors, however, will not be delayed.

All data on the 20 LES motor qualification tests, except thrust vector and roll values, were received and are within specification. Lockheed is completing analysis of the thrust vector and roll data.

Qualification test data on 16 of the 21 pitch control motors tested were received from Lockheed, and are being evaluated.

The boilerplate 15 LES appeared to function normally, and was not observed to break up despite reaching a tumbling rate of about two revolutions per second approximately four seconds after motor ignition.

Propulsion Analysis

Service module RCS quad and engine data from the boilerplate 15 flight are being evaluated. The maximum temperature recorded for the injector head was 150 F compared with a predicted temperature of 380 F; thus, boost heating appears to be less severe than predicted.

At a meeting of S&ID, Grumman, and NASA at Houston, the following decisions were made regarding the thermal control of the service module RCS engines:

1. Engine design should include the fuel standoff valve.

2. S&ID and Grumman should design their spacecraft to accept this engine.

3. S&ID will study the feasibility of passive thermal control for the cislunar mission.

4. S&ID may add electrical heaters for thermal control during lunar orbit.

Thermal studies of the command module RCS during earth orbit indicate that the RCS engine valves may cool below the propellant freezing point. Either passive or electrical thermal control will be needed.

Rocketdyne's proposed program to qualify the command module RCS nozzle extension was reviewed by S&ID. The proposed tests would not define ablation phenomena adequately and are being delayed pending review of thermophysical data and chemical analysis of a fired nozzle extension.

The feasibility of replacing the expulsion bladders of the command module RCS tank with multiple retention screens was established in a preliminary study. Tests under standard gravity conditions are now being planned to support design effort.

The second series of zero-g propellant behavior tests in the KC-135 aircraft was completed. Five flights furnishing about 125 parabolas were made during the week of September 14. The effects of command and service module rotation and SPS shutdown on SPS sloshing were measured and are being analyzed.

The predicted interplay between parallel SPS helium pressure regulators was confirmed in tests. Severe and damaging oscillation occurred. Possible solutions to this problem are being studied.

GROUND SUPPORT EQUIPMENT (GSE)

Acceptance Checkout Equipment (ACE-SC)

Interface tests were completed between the carry-on pulse code modulation (PCM) subsystem and the data interleaving subsystem, and between the latter and the General Electric decommutator. Also, the interface tests between the carry-on PCM and the digital signal conditioning with multiplexing unit were completed. The third module of this signal conditioning unit and one module of the analog signal conditioning and sampling unit were delivered by Autonetics to S&ID, Downey. The digital test command subsystem (DTCS) carry-on baseplate unit, and the external DTCS for boilerplate 14 were shipped to S&ID, Downey, by Control Data Corporation.

Special Test Units (STU)

The acceptance test was completed on the four bays for the SPS checkout and firing control STU, and the equipment was delivered to S&ID.

GSE Cable Subsystem Status

During this report period, 620 new drawings and 89 change drawings were released. These drawings covered cable and J-box requirements for boilerplates 14 and 22, spacecraft 006, 008, and 009, and test fixture F-2.

Launch Complex 34 at Cape Kennedy

Major GSE problems for this complex were studied and solutions were developed as follows:

1. The requirements for filtering spacecraft dc power were satisfied by locating a capacitance filter on the umbilical swing arm.

2. The space problem in the automatic ground control station room was resolved by repackaging the following GSE models into fewer bays: the servicing equipment ACE-SC adapter, the load bank electrical unit, the electrical control switching unit of the GSE fluid distribution subsystem, the purge monitor and control unit, and the distribution panel for dc ground power.

Spacecraft Instrumentation Test Equipment (SITE)

SITE subsystem 1 was delivered by Autonetics to S&ID, Downey; checkout of the unit will be completed in time to support boilerplate 14 and spacecraft 009. Drawings were completed and procurement was initiated for the SITE instrumentation test fixtures to support the first need date of ACE-SC testing on December 18.

Basic Water Transfer Unit

The water transfer unit, designed and manufactured by S&ID, Tulsa, will be used to service the spacecraft water management subsystem and to remove water accumulated in the spacecraft vapor vent tube. This unit will contain 400 pounds of water—sufficient for the necessary flush and fill operations. A vacuum ejector will provide suction to remove water from the spacecraft vapor vent tube. Engineering acceptance tests are being conducted at Tulsa with delivery scheduled for late October.

Service Module Transport Fixture

The service module transport fixture was fabricated and successfully fit-checked on boilerplate 27. This item will be used only for air transportation of the boilerplate 27 and spacecraft service modules in the B-377-PG aircraft.

GSE Design Criteria

Reliability engineering and GSE engineering will make a joint comprehensive review of all mission-essential GSE. The objectives of this review are twofold:

1. To reduce the size of the existing list

2. To restrict criticalness for end-items to actual critical functions only

   Example: A restricted process specification may be critical in regard to a fluids function, but not critical electrically; therefore, a possible relaxation in soldering requirements may be possible.

GSE Models Delivered

The following models of GSE equipment were delivered to support the spacecraft program:

SPS engine gimbal locking link
SPS engine nozzle extension closure
Thrust chamber assembly alignment BME

[redacted]

Temperature calibration unit
Up-data link BME
Helium ready storage unit
Thrust vector control amplifier test set
Engine ON-OFF control amplifier test set

SIMULATION AND TRAINERS

Fabrication was completed on the SPS engine simulator, including control console and power supply rack, and incorporation in the simulation complex at S&ID, Downey, was started. The SPS simulator is an electromechanical device that simulates the operation of the SPS engine. The unit contains adjustable mass-moment arms around both the pitch and yaw axes to simulate the moment of inertia of the SPS engine. Each arm is driven by the same electromechanical actuator subsystem that is used in the Apollo spacecraft. All hardware required to operate the unit is available except the actuators, scheduled for delivery the last of October. Installation will be completed and functional checkout of the unit is scheduled for completion in early January.

The SPS simulator will be employed first in mission simulation study for spacecraft 009, to begin January 15. The unit will be used in conjunction with computers and prototype spacecraft SCS equipment. Subsequent SPS simulator studies will provide closed-loop operational characteristics of the thrust vector subsystem.

VEHICLE TESTING

Assembly and test operations for boilerplate 23 were completed at S&ID, Downey, and the vehicle was shipped to White Sands for field test operations. The vehicle will be the first to demonstrate the LES with the canard and the first to demonstrate the command module boost protective cover. The boost phase will employ a Little Joe II; abort initiation will be approximately 30,000 feet, apogee at approximately 50,000 feet.

Boilerplate 27, the structural dynamic test vehicle, was completed and shipped to NASA-MSC, Houston. Structural dynamic tests will be accomplished with the command and service modules stacked. Following these tests, the vehicle will be shipped to NASA-MSFC, Huntsville, for a total-stack dynamic test that includes the boosters.

Initial checkout was completed on the electrical distribution subsystem and the ECS of the boilerplate 14 command and service modules. The stack is now undergoing checkout of the communication and instrumentation subsystems.

[redacted]

The girth shelf was installed in the spacecraft 006 crew compartment, and the compartment successfully passed acceptance pressure tests for structural integrity. Bonding problems discovered in secondary structure components of the command module are being corrected. The rework and testing are being accomplished without interfering with installation schedules for the secondary structure.

The spacecraft 007 service module will be used for the SPS dynamic gimbal test. The boost protective cover was deleted from this vehicle; however, the apex "hard" portion of the boost protective cover will be used for spacecraft 004 static tests.

All spacecraft 001 wiring installations were completed, and the service module is undergoing tests for electrical continuity and possible shorts. The vehicle is expected to be ready for a NASA design engineering inspection about October 24.

RELIABILITY

The third qualification static-test firing of the tower jettison motor at Thiokol resulted in the destruction of the motor and attached interstage structure. A review of the high-speed motion pictures of the firing showed that the failure was initiated by the separation of the spot-welded joints between the forward and aft attachment rings and the primary structure of the interstage assembly. Investigation of the manufacturing and inspection methods used by the interstage supplier showed poor spot-weld techniques and inadequate in-process inspection. All present interstages are being adequately strengthened, and the design has been changed to correct the problem.

The qualitative results of a reliability study performed on the hydraulic bipropellant valve actuator of the SPS engine are as follows:

1. Extremely tight tolerances are required for O-ring seals on the inlets and outlets of the two-way and three-way valves.

2. The double O-rings on a moving piston that replaced the actuator closing bellows may result in fuel leakage directly from the fuel tank at any time during flight.

3. Two single-failure possibilities are contained in the two-way pilot valve: fuel leakage past the poppet seat and around the insert.

A comparison was made of several types of valve actuation including hydraulic, electric, and pneumatic. The electric actuator has the highest reliability potential, but would require extensive development. Resolution of deficiencies in the hydraulic actuator design would have to be accomplished before the hydraulic reliability would exceed that of the proposed pneumatic actuator. The additional components in the pneumatic actuator would degrade mission success, but would eliminate all single-point failures. The pneumatic actuator could result in an improvement in cost and schedule.

Reliability studies were made of proposed methods to implement the NASA requirement for the simultaneous transmission of recorded and real-time telemetry, voice, Doppler tracking, and pseudo-random noise (PRN) ranging. The present configuration of the S-band equipment consists of a single transmitter with either a frequency modulation (FM) or a pulse modulation (PM) capability. Thus, PM and FM modulation cannot be accomplished simultaneously. The PM subcarrier is used to transmit real-time telemetry, voice, Doppler tracking, and PRN ranging information—all essential to mission success. The FM subcarrier is used to transmit recorded information. The following proposed methods for adding this simultaneous capability were considered:

1. The addition of a third PM subcarrier with redundant power amplifier

2. The addition of a separate FM transmitter

   a. A single FM transmitter with redundant power amplifier

   b. Redundant FM transmitters with redundant power amplifier

From a reliability standpoint, the addition of a third PM subcarrier with redundant power amplifier is recommended as the best method of implementing the additional requirement.

INTEGRATION

The boilerplate 15 launch at Cape Kennedy on September 18 required four holds because of booster and facility problems; no holds were required for the spacecraft.

Boilerplate 15 telemetry was satisfactory, with reception improved over that of boilerplate 13. Instrument performance appeared good, with the failure of only one calorimeter and one thermocouple. The failed calorimeter was located forward of and very close to RCS quad "A," and corresponded to the instrument on boilerplate 13 that also failed. (However, two other boilerplate 15 calorimeters corresponding to two failed instruments on boilerplate

13 gave valid data.) The failed boilerplate 15 thermocouple was on the flange of the forward-facing nozzle of RCS quad "A," in an area that was expected to attain the highest temperatures.

RCS quad "A," the only one instrumented, contained a total of 12 thermocouples and 4 resistance thermometers. The temperatures recorded by these instruments were considerably lower than expected. A review of procedures has disclosed that the thermocouple installation differed from that on which predictions were based. Investigation is continuing on the two apparent instrument failures and the RCS quad "A" anomalies. The remainder of the 133 measurement sensors on boilerplate 15 functioned satisfactorily.

S&ID presented an Apollo electromagnetic compatibility (EMC) program to NASA and Bellcom on September 24. The briefing covered the following subjects:

1. The S&ID EMC program

2. Major subcontractor compliance with EMC specifications

3. Major subcontractor plans to achieve EMC compliance

4. EMC status of spacecraft 009 subsystems

5. Mission-essential GSE to be EMC-qualified for spacecraft 009

6. Known EMC problems and plans for corrective action

7. Grounding system for boilerplate 14 and ACE-SC at Building 290, S&ID, Downey

8. Adequacy of grounding associated with the service tower at Cape Kennedy

9. EMC differences for spacecraft 008, 009, 011, 012 and production Block I spacecraft subsystems

NASA agreed to an accelerated EMC effort that will cover EMC testing of one of each kind of spacecraft subsystem black box, one of each kind of mission-essential GSE, and spacecraft spectrum signature testing.

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The preliminary Block II command and service module mock-ups (Figures 5, 6, and 7) were presented to NASA at the design engineering inspection (DEI) September 29, 30, and October 1; 106 requests for change were categorized as follows: 67 action, 23 study, 12 rejected, and 4 not applicable.

The following four important documents were published during this report period:

1. Vehicle Ground Operations Plan, SID 64-1368 (Block II)
2. Lunar Excursion Module Performance and Interface Specification, SID 62-1244 (Block II)
3. Boilerplate 23 Launch Vehicle Performance and Interface Specification, SID 63-948 (Little Joe II)
4. Boilerplate 23 Interface Control Document, MH01-04012-414 (Little Joe II)

The Block I command and service module subsystem specification (SID 63-313) and the Block I model specification (SID 64-1237) were also released and transmitted to NASA-MSC. Negotiations of the Block I system and model specifications were conducted at NASA-MSC from September 24 through September 27, and agreements were reached on the Block I configuration. Both system and model specifications are being revised to reflect these agreements, and are scheduled for final release in early October. The Block I system and model specification will be incorporated into Contract NAS9-150 to replace the present Exhibit B.

The proposed Block II command and service module system specification (SID 64-1344) and the command and service module model specification (SID 64-1345) were released as scheduled on September 30 for the Block II DEI.

S&ID, Grumman, MIT, and NASA held several coordination meetings to consider checkout requirements for RF subsystems. The following decisions resulted:

1. Radar boresight, RF, and RF interference tests will be conducted only at the RF systems test facility at Cape Kennedy.
2. Open-loop testing of the radar subsystems will be conducted in the operations and checkout building at the Florida facility.

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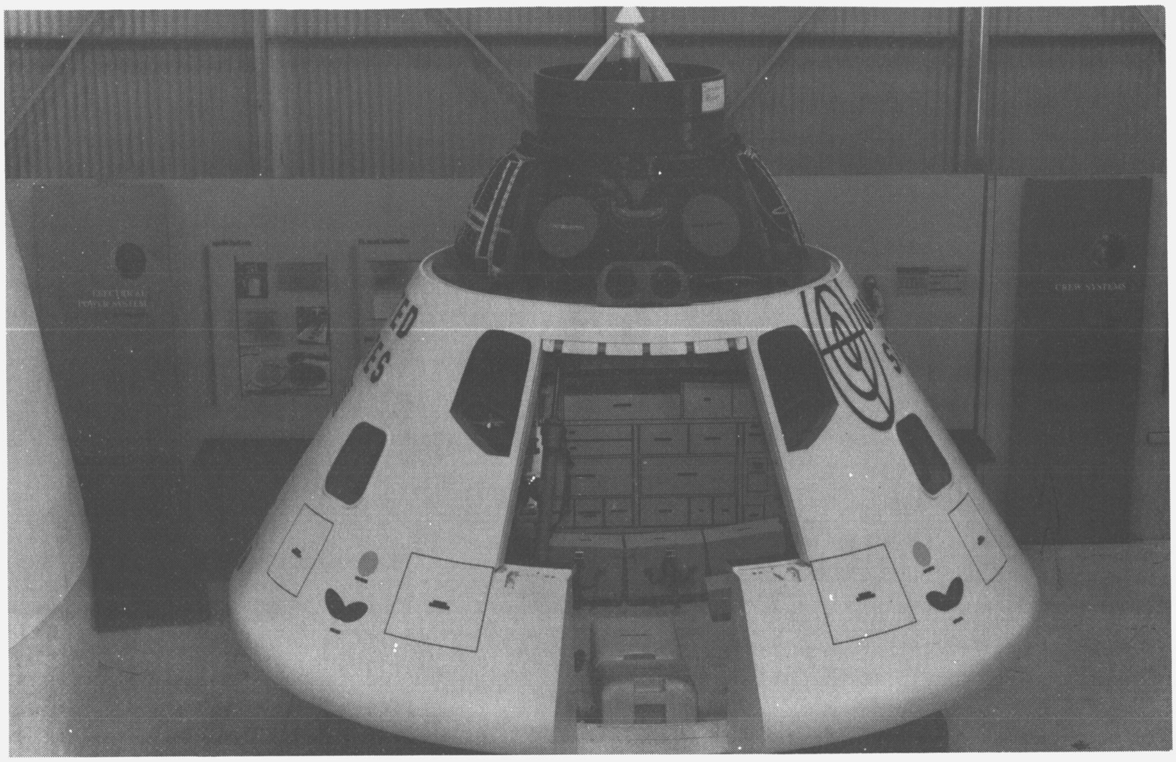

Figure 5. Preliminary Block II Command Module Mock-up

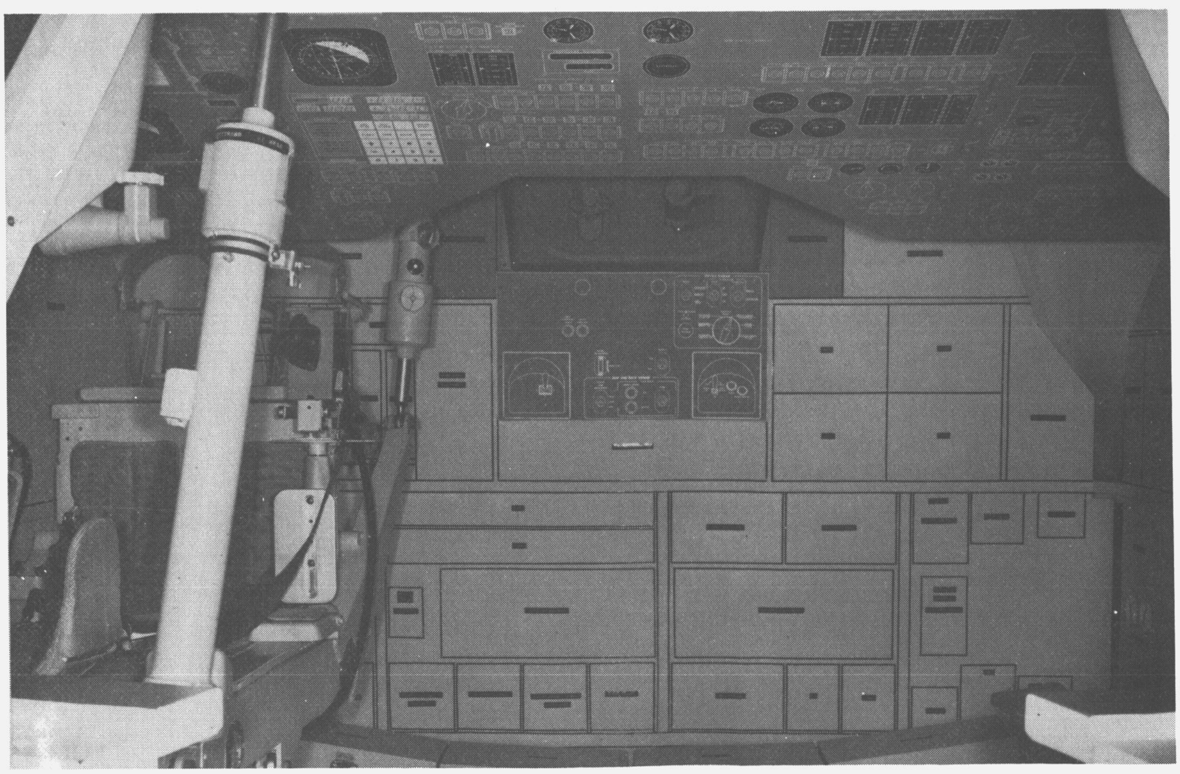

Figure 6. Interior of Preliminary Block II Command Module Mock-up

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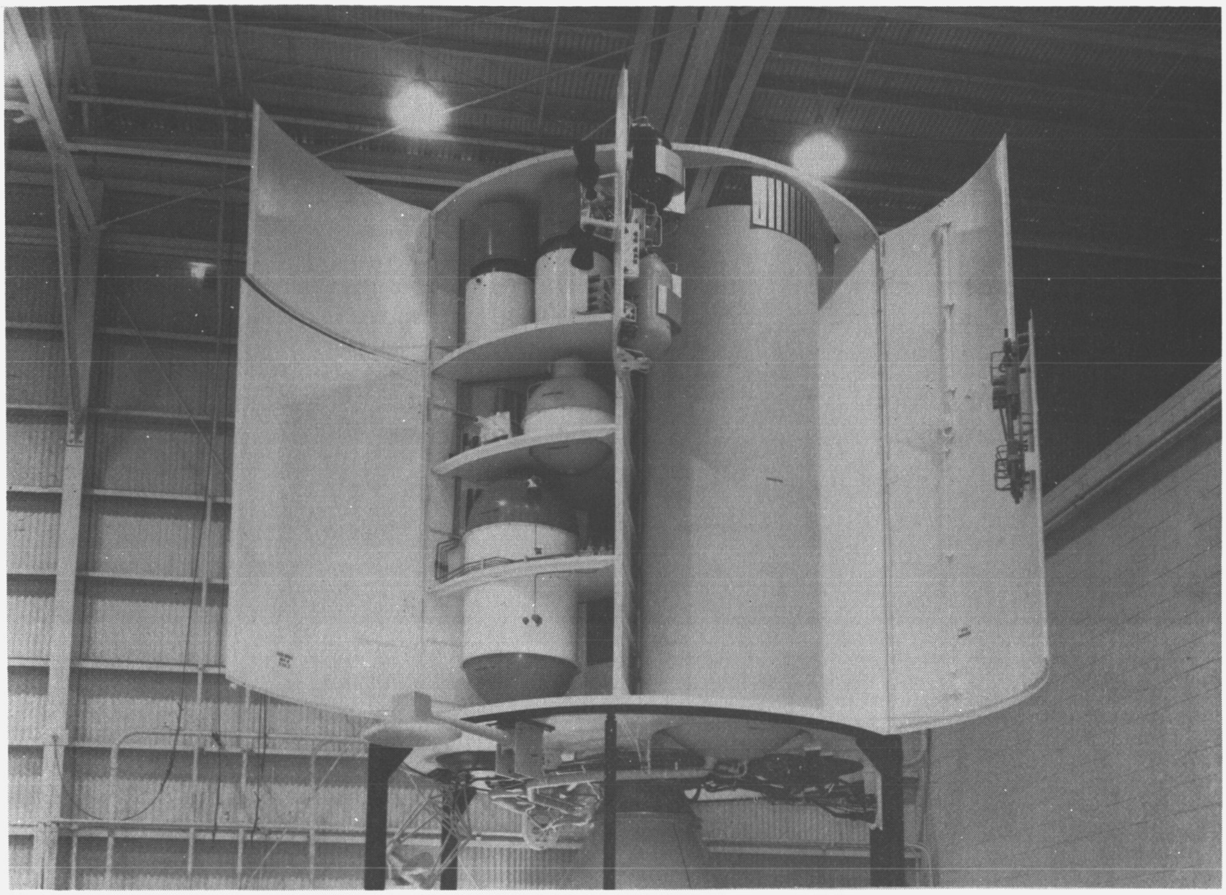

Figure 7. Preliminary Block II Service Module Mock-up

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OPERATIONS

DOWNEY

Boilerplate 23

Shipping preparations for the boilerplate 23 command module were completed, and the module was loaded on a C-133 aircraft on September 18. The launch escape tower and canard were shipped by truck on September 19, arriving at WSMR on September 21.

Boilerplate 14

Modifications of the environmental control subsystem (ECS) configuration were completed. Pressure, contamination, and servicing checkouts of the ECS were accomplished. Functional checkout was completed on the ECS cooling loops.

Panels, black boxes, and wiring were installed for the electrical power subsystem (EPS) checkout. Command module wiring continuity checks were completed. Installation of the Westinghouse inverters was accomplished on October 5, and checkout was completed on October 7. Checkout of the power distribution portion of the EPS was accomplished.

A defective service propulsion subsystem (SPS) engine actuator was removed and replaced. The checkout of the signal conditioners and the central timing equipment was completed on October 12.

During the next report period, checkout will be completed on the stabilization and control subsystem, reaction control subsystem, and service propulsion subsystem. Detailed planning for ACE station 1 activation will be completed.

WHITE SANDS MISSILE RANGE (WSMR)

Propulsion System Development Facility (PSDF)

An investigation of the unsuccessful fuel circulation test revealed improper operation of the male half of the quick disconnect that allowed fuel to flow in only one direction. The malfunctioning quick disconnect was reversed and allowed fuel to flow to the test stand. The fuel and oxidizer tanking tests were then accomplished satisfactorily.

All modifications and pickup tasks on the fluid distribution unit were completed, and the unit was prepared to support the first hot firing. The postfire purge modification was completed on September 17. The preinspection purge installation was then accomplished.

A rerun of the closed circuit television system, a simulated engine firing countdown, and a pretest meeting were accomplished on September 21. Countdown for the first test fixture F-2 hot fire test on September 22 was completed by ignition that occurred approximately eight seconds after fire switch actuation. Ignition was followed, in 0.8 seconds, by rough combustion safety cutoff. Analysis of data indicated that the rough combustion safety cutoff function operated as designed. Combustion cutoff occurred when 60-g peak-to-peak loading of the engine was experienced. The test stand deluge was activated during the preinspection purge because of a flashback fire, but only minor scorching of the hardware was sustained.

The engine troubleshooting functional check indicated the need for replacement of the thrust chamber ball valve assembly. Detanking of the fuel and oxidizer was accomplished, and on September 28 the engine was reinstalled. Fuel tanking was accomplished on September 29, and oxidizer tanking on September 30.

Hot fire test 1A was conducted successfully on October 1. Test duration was 10 seconds. Real-time data indicated that all parameters were within tolerance except the oxidizer flow indicator. The oxidizer flow rate instrumentation malfunctioned during engine start and remained inoperative. A system check was performed satisfactorily on October 7. Test 2, conducted on October 13, was a 20-second firing of service propulsion engine 0006. Preliminary evaluation of real-time data indicated a normal start and engine shutdown. Steady-state operation indicated nominal chamber pressure, thrust, and oxidizer interface pressure; the fuel interface pressure, however, was slightly below nominal with slightly high fuel flow rate. There were no configuration changes to be accomplished, and preparation was directed toward performing test 3. Test 3 consisted of a 10-second firing, followed by a 5-minute wait, then a 30-second firing. Visual observations of the test indicated a successful series firing. No abnormal indications were observed, and real-time engine performance data were normal.

The firing schedule consists of firing tests to demonstrate the capabilities of the engine. The tests will consist of a series of operations: a 30-second firing, a 5-minute shutdown followed by a 180-second firing, three 30-second firings (detank between firings), a 120-second firing, six 10-second firings, and five 5-second firings.

Mission Abort

Boilerplate 23 launch escape subsystem (LES) wire harness continuity checks were completed on September 16. The launch escape tower was received at WSMR on September 21.

The canard section of the LES was installed on September 25. The canard area ballast installation was performed on October 1.

The command module receiving inspection was completed on September 23. Buildup of the earth landing subsystem (ELS) was begun on September 25 with the installation of the parachute retention flaps and pilot mortar breakwires. The three main parachutes were installed. An ELS harness continuity test was completed on September 29. All ELS pyrotechnics were received, and the cartridges were installed on October 1.

The command module top-deck closeout was completed on October 7. The forward compartment cover was reinstalled for the vertical weight and balance operations. The horizontal and vertical weight-and-balance operations were completed. Final assembly of the LES is approximately 95 percent complete. The Q-ball was installed on October 7, and installation of the canard doors was completed.

Checkout of the Little Joe II simulator was completed on September 29. Fabrication of the intercommunications panel was completed on September 30.

GSE installation in the pad area was completed. The LES sequencer bench maintenance equipment unit was installed in the checkout trailer on October 12. Thrust vector alignment operations were completed on October 13. The canard system position potentiometer, brackets, and strain-gauged links were installed on October 14.

A premate shakedown of the service module, command module, and LES was completed on October 14. The service module was mated to the Little Joe II booster.

During the next report period the thrust vector alignment will be completed. The command module will be moved to the pad and mated to the service module. The soft and hard boost protective cover will be installed, and the LES will be mated to the command module. Preparations for vehicle checkout will be continued, and the spacecraft will be mated to the Little Joe II booster.

FLORIDA FACILITY (FF)

Boilerplate 15

Boilerplate 15 (SA-7, mission A-202) was successfully launched from complex 37B, Cape Kennedy, at 1122:43 hours EST on September 18, 1964. The spacecraft demonstrated the alternate mode of launch escape tower jettison and obtained further verification of the launch and exit environmental parameters. The orbital parameters were the following: a period of 88.5 minutes, an apogee of 123 nautical miles, and a perigee of 100 nautical miles. The orbiting vehicle consisted of the spacecraft (approximately 8.5 tons), the S-IV instrumentation unit, and the burned-out S-IV stage.

Range data indicated satisfactory telemetry and C-band radar operation from the three spacecraft telemetry links and the two C-band beacon subsystems. No problems with any spacecraft subsystem were indicated during real-time analysis of the telemetered data. Loss of telemeter signal occurred at T + 441 seconds as the vehicle went over the horizon. Boilerplate 15 returned to earth in the south Indian Ocean during its fifty-ninth orbit (estimated at 0700 hours EST) on September 22. Data analysis indicated that two measurements (one reaction control subsystem thermocouple and one calorimeter) failed to respond during the mission.

Removal of boilerplate 15 GSE from hangar AF and pad 37B was completed on October 5. The checkout equipment not needed for Boilerplate 16 was returned to Downey.

Boilerplate 16

The boilerplate 16 schedule was revised because of a change in the micrometeoroid package delivery schedule. A revised schedule for boilerplate 16 will be available as soon as the booster schedule is published. The four explosive bolt bodies from boilerplate 16 LES were shipped to WSMR to support operations with boilerplate 23. The 60-day delay in the boilerplate 16 schedule allows time for delivery of a new set of explosive bolt bodies in support of boilerplate 16.

The LES buildup operation was removed from the ordnance building at the Merritt Island Launch Area (MILA) to the pyrotechnic installation building (weight and balance building) at MILA. Installation of the launch escape motor and skirt assembly was completed on September 30. Thrust vector alignment adjustment on the launch escape motor was accomplished on October 1. The LES wiring continuity and insulation test was completed. The dual-mode tower feet were removed and replaced by new single-mode tower feet.

The boilerplate 16 schedule, revised to reflect the 60-day slippage of the micrometeoroid package delivery schedule, will be released as soon as the booster schedule is published by NASA-MSFC. The LES buildup and checkout will be completed during the next report period. The end of boilerplate 16 field operations is currently scheduled for February 1965.

Modification of the loose-equipment storage box on the hoist beam was completed on October 13. Modification of the spacecraft support ring was completed on October 15. Length was increased on the bolts that attach the adapter to the ring.

Spacecraft 009

The preliminary spacecraft 009 operations plan is scheduled for release on October 23. New information on postflight recovery and checkout operations is being incorporated as part of this plan. The released facilities verification mock-up operations plan is scheduled for publication on October 21. The LES is scheduled for delivery to the Florida facility on October 30, the spacecraft/lunar excursion module adapter on November 15, the command module on December 30, and the service module on January 15, 1965.

FACILITIES

DOWNEY

Quality Verification Vibration Testing System, Building 290

The target date for starting the vibration tests requested on a revision to contract change authorization 158 has been advanced to March 15, 1965, from July 30, 1965, in an attempt to support spacecraft 009. Purchasing issued the single-source bid request to Ling Electronics on October 8. The job was inspected October 12, and the bid is expected on or before October 23, 1964.

Acceptance Checkout Equipment (ACE-SC) 3, Building 290

All purchase orders for ACE implementation have been placed, and work has been started.

Relocation of GSE-SMD Manufacturing from Slauson to Compton

The contract for occupancy construction on the west side of the Compton facility, building 341, was awarded October 9, 1964, and work began October 12, 1964. Completion is scheduled in six weeks.

Impact Test Facility

Construction to enlarge and deepen the pool at the impact test facility was completed as scheduled on October 2.

Preinstallation Acceptance (PIA)

A contract change authorization has been received requiring S&ID to furnish electromagnetic checkout equipment for PIA support at offsite locations and at Downey. This may require a major S&ID facilities effort.

APPENDIX

S&ID SCHEDULE OF APOLLO MEETINGS AND TRIPS

S&ID Schedule of Apollo Meetings and Trips
September 16 to October 15, 1964

Subject	Location	Date	S&ID Representatives	Organization
Bimonthly NASA-NAA technical management meeting	Houston, Texas	Sept. 16 to 17	McCarthy, Ryker, Pyle	S&ID, NASA
Crew safety system panel meeting	Houston, Texas	Sept. 16 to 17	Hafner	S&ID, NASA
Apollo checkout panel meeting	Cape Kennedy, Florida	Sept. 16 to 18	Siwolop, Millikenz, Dale	S&ID, NASA
First firing of service propulsion system test fixture F-2	White Sands, New Mexico	Sept. 16 to 18	Bellamy, Field	S&ID, NASA
Specification revisions meeting	Berkeley, California	Sept. 16 to 18	Spencer	S&ID, Hexcel
Field operations support meeting	Cocoa Beach, Florida	Sept. 16 to 19	Skene, Petrey, Stephens	S&ID, NASA
Toggle switch specification negotiation, meeting	Freeport, Illinois	Sept. 16 to 23	Beeler, Robson	S&ID, Micro-Switch
Revised test procedure review	Sacramento, California	Sept. 17 to 18	Sorensen	S&ID, Aerojet
GSE technical management coordination meeting	Houston, Texas	Sept. 17 to 20	Bailey	S&ID, NASA
Preflight field testing and checkout supervision	Las Cruces, New Mexico	Sept. 18 to Dec. 18	Brooks	S&ID, NASA
Test data and procedures review	Buffalo, New York	Sept. 20 to 25	Burge	S&ID, Bell
Design review meeting	Southampton, Pennsylvania	Sept. 20 to 22	Musso, McFarland, Wzkiecwitz	S&ID, Vector
EMC meeting	Cocoa Beach, Florida	Sept. 21 to 24	Pumphrey, Lowell	S&ID, NASA
Supplier facility survey	Dallas, Texas	Sept. 21 to 25	Dykstra, Bettis, Ellis, Westfall	S&ID, Chance Vought
Ablative heat shield program review and surveillance	Middletown, Ohio	Sept. 21 to Oct. 16	Wagner	S&ID, Aeronca
Roll orientation, problem resolution	Bethpage, L.I., New York	Sept. 22 to 24	Beam	S&ID, Grumman
Configuration control coordination	Cedar Rapids, Iowa	Sept. 22 to 24	Highland	S&ID, Collins
Delivery schedules, meeting	Tarrytown, New York	Sept. 22 to Oct. 7	Hobson	S&ID, Simmonds

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S&ID Schedule of Apollo Meetings and Trips
September 16 to October 15, 1964 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Technical status review	Buffalo, New York	Sept. 23 to 25	Gibb, Wagner	S&ID, Bell
Specifications briefing	Houston, Texas	Sept. 23 to 25	Ross	S&ID, NASA
Electromagnetic compatibility presentation and review	Houston, Texas	Sept. 23 to 25	Edziak, Hirahara	S&ID, NASA
Test plan objectives, discussion	Tullahoma, Tennessee	Sept. 23 to 25	Cadwell, Koppang	S&ID, NASA
Block II attitude rules and criteria, meeting	Houston, Texas	Sept. 23 to 25	Henley, Mielak	S&ID, NASA
Block I specifications, negotiation	Houston, Texas	Sept. 23 to 25	Wheeler, Karl, Nicholas, Kinsler, Dodds, Levine, Nelson, Cook, Page, Zemenick	S&ID, NASA
Antenna systems Block I and II communications, meeting	Houston, Texas	Sept. 27 to 29	McCabe, Bologna, McQuerry, Ross	S&ID, NASA
Cryogenic system coordination meeting	Las Cruces, New Mexico	Sept. 27	Segard	S&ID, NASA
Radar design review meeting	Bethpage, L.I., New York	Sept. 27 to 28	Damm	S&ID, Grumman
Fabrication problems, evaluation	Tarrytown, New York	Sept. 27 to Oct. 2	Bratfisch, McKellar	S&ID, Simmonds
Steering committee meeting	Bethpage, L.I., New York	Sept. 28 to 29	Milliken, Gustavson, Mansfield, Jacobson, Garton, Kranz	S&ID, Grumman
Working group meeting on boilerplate 27 test plan	Huntsville, Alabama	Sept. 27 to 30	Tooley, Brown	S&ID, NASA
Preliminary results of passive thermal control study presentation	Houston, Texas	Sept. 28 to 29	Barnett, Merhoff, Svenson, Eberle	S&ID, NASA
Integrated guidance and control lunar excursion module meeting	Houston, Texas	Sept. 28 to 29	Walli	S&ID, NASA
Fiscal year 1965 budget review	Boulder, Colorado	Sept. 28 to 30	Templeton, Bouman, Frost	S&ID, Beech
Configuration of guidance and navigation system, meeting	Cambridge, Massachusetts	Sept. 28 to 30	Hebert, Fatton	S&ID, MIT
Subcontractor review meeting	Binghamton, New York	Sept. 28 to Oct. 2	Freedman	S&ID, General Precision

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S&ID Schedule of Apollo Meetings and Trips September 16 to October 15, 1964 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Design review meeting	Houston, Texas	Sept. 28 to Oct. 2	Dimitruk, Ferguson, Petak, Mooney, Miller	S&ID, NASA
Engineering liaison	Las Cruces, New Mexico	Sept. 28 to Oct. 3	Teter	S&ID, NASA
Model wind tunnel tests	Cleveland, Ohio	Sept. 28 to Oct. 19	Udvardy, Kofenstein	S&ID, NASA
Qualification tests, technical support	Minneapolis, Minnesota	Sept. 28 to Oct. 23	Radeke	S&ID, Honeywell
Simulation program presentation	Houston, Texas	Sept. 29 to Oct. 1	Barnett, Bennett, Robertson, Chamberlain, Dudek, Levine	S&ID, NASA
Monthly coordination meeting	Minneapolis, Minnesota	Sept. 29 to Oct. 2	Wallace	S&ID, Control Data
Simulation program plan presentation	Houston, Texas	Sept. 29 to Oct. 2	Barnett, Dudek	S&ID, NASA
Delivery schedule evaluation	Tarrytown, New York	Sept. 30 to Oct. 2	Wermuth, Field	S&ID, Simmonds
GSE and checkout presentation	Houston, Texas	Sept. 30 to Oct. 2	Harkins, Gilson, Morris	S&ID, NASA
Review of hardware status	Tarrytown, New York	Sept. 30 to Oct. 3	Field	S&ID, Simmonds
Specification changes, review	Allentown, Pennsylvania	Sept. 30 to Oct. 6	Kicinski, Ollodort	S&ID, Air Products & Chemicals
Quality assurance requirements, review	Houston, Texas	Sept. 30 to Oct. 2	Cadwell	S&ID, NASA
Milestone accomplishments, review	Rolling Meadows, Illinois	Oct. 1	Beeman, Brown	S&ID, General Time
Television program status, review	Houston, Texas	Oct. 1 to 2	Moreno, Kolb, Dunphy, Lowrance	S&ID, NASA
Vehicle ground operations coordination	Houston, Texas	Oct. 1 to 2	Courtis	S&ID, NASA
ASPO editorial review board meeting	Houston, Texas	Oct. 1 to 4	Emrich	S&ID, NASA
Supplemental agreement negotiation	Bethpage, L.I., New York	Oct. 4 to 6	Drucker	S&ID, Grumman
Thermal simulators, discussion	Minneapolis, Minnesota	Oct. 4 to 7	Sheere, Percy	S&ID, Honeywell
Development activities survey	Santa Clara, California	Oct. 4 to 6	Lee	S&ID, Explosive Technology
Engineering coordination meeting	San Diego, California	Oct. 4 to 6	Proctor	S&ID, General Dynamics

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S&ID Schedule of Apollo Meetings and Trips September 16 to October 15, 1964 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Program review and schedule negotiation	Cedar Rapids, Iowa	Oct. 4 to 9	Hagelberg	S&ID, Collins
Technical coordination meeting	San Diego, California	Oct. 5 to 6	Batson	S&ID, General Dynamics
Cryogenic system coordination	Las Cruces, New Mexico	Oct. 5 to 7	Segard	S&ID, NASA
Common usage equipment, discussion	Bethpage, L.I., New York	Oct. 5 to 7	Neatherlin	S&ID, Grumman
Lunar excursion module M-5 mock-up review	Bethpage, L.I., New York	Oct. 5 to 8	Smith	S&ID, Grumman
Fluid distribution system concept design review	Las Cruces, New Mexico	Oct. 5 to 8	Wogensen	S&ID, NASA
Project engineering coordination	Sacramento, California	Oct. 5 to 9	Mower	S&ID, Aerojet
Design engineering review	Bethpage, L.I., New York	Oct. 6 to 7	Kehlet, Fagan, Walkover	S&ID, Grumman
Program and valve design changes, discussion	Sacramento, California	Oct. 6 to 8	Bellamy, Cadwell	S&ID, Aerojet
Technical problems coordination and review	Stamford, Connecticut	Oct. 6 to 8	Ross	S&ID, Barnes Electric
Ground development test working group meeting	Bethpage, L.I., New York	Oct. 6 to 8	Russell, Jones, Severine, Myer	S&ID, Grumman
Test data working group meeting	Bethpage, L.I., New York	Oct. 6 to 9	Rutkowski, Christy, Mansfield, Githens, Egan	S&ID, Grumman
Compatibility test program support	Houston, Texas	Oct. 6 to 30	Whitanis	S&ID, NASA
Central timing equipment milestone status, review	Rolling Meadows, New York	Oct. 7 to 9	Hagelberg, Treman	S&ID, General Time
Design review meeting	Boulder, Colorado	Oct. 7 to 9	Haglund	S&ID, Beech
Engineering coordination meeting	Houston, Texas	Oct. 8 to 9	Fouts, Hogan, Falco, Johnson	S&ID, NASA
Acceptance testing criteria, discussion	Houston, Texas	Oct. 8 to 9	Frazier, Finley, Hatchell, Bennington	S&ID, NASA
Engineering coordination meeting	Houston, Texas	Oct. 8 to 9	Nicholas	S&ID, NASA

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S&ID Schedule of Apollo Meetings and Trips
September 16 to October 15, 1964 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Design details, review	Houston, Texas	Oct. 8 to 9	Campbell, Pivar	S&ID, NASA
Lighting system design and mock-up review	Bethpage, L. I., New York	Oct. 8 to 9	McCarthy, Nelson, Troolines	S&ID, Grumman
Test requirements, discussion	Houston, Texas	Oct. 11 to 12	Graham	S&ID, NASA
Vehicle ground operations plan, coordination	Cocoa Beach, Florida	Oct. 11 to 14	McCloskey	S&ID, NASA
Engineering review meeting	New Hyde Park, New York	Oct. 11 to 15	Moen	S&ID, Consolidated Ohmic Devices
Critical design review meeting	Little Falls, New Jersey	Oct. 11 to 16	Teravskis, Temoyan	S&ID, G. P. I.
Engineering activities coordination	Houston, Texas	Oct. 11 to 18	Boykin	S&ID, NASA
Facility survey	Dallas, Texas	Oct. 12 to 13	Wickline, Gibb	S&ID, Jet Research
Simulation program results, review	Houston, Texas	Oct. 12 to 13	Sandberg, Woosley	S&ID, NASA
Technical progress evaluation	Sacramento, California	Oct. 12 to 16	Mower	S&ID, NASA
Spare parts proposal fact-finding meeting	East Hartford, Connecticut	Oct. 12 to 16	O'Reilly	S&ID, Pratt & Whitney
Production control and checkout procedures, coordination	Houston, Texas	Oct. 12 to 14	Olson	S&ID, NASA
Engineering coordination meeting	Minneapolis, Minnesota	Oct. 12 to 17	Pumphrey, Lanza	S&ID, Honeywell
Engineering liaison	Las Cruces, New Mexico	Oct. 12 to 30	Thurman	S&ID, NASA
Technical coordination meeting	Santa Clara, California	Oct. 13	Matisoff	S&ID, Dalmo Victor
Guidance and navigation implementation meeting	Houston, Texas	Oct. 13 to 14	Quebedeaux	S&ID, NASA
Lunar excursion module adapter, task force meeting	Huntsville, Alabama	Oct. 13 to 14	Radey	S&ID, NASA
Design requirements, review	Houston, Texas	Oct. 13 to 14	Atlas	S&ID, NASA
Thermal simulators, discussion	Minneapolis, Minnesota	Oct. 13 to 14	Brannen	S&ID, Honeywell

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S&ID Schedule of Apollo Meetings and Trips September 16 to October 15, 1964 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Mission planning, task force meeting	Bethpage, L.I., New York	Oct. 13 to 15	Lopez	S&ID, Grumman
SPS engineering design review meeting	Sacramento, California	Oct. 13 to 16	Fow	S&ID, Aerojet
Facilities investigation	Grand Prairie, Texas	Oct. 13 to 16	Reithmaier	S&ID, Ling-Temco-Vought
Development flight documentation identification, meeting	Houston, Texas	Oct. 14 to 15	Cole, Rider, Steinwachs, SeLegue, Helms	S&ID, NASA
Potential program, management and status review	Houston, Texas	Oct. 14 to 15	Hirahara	S&ID, NASA
Acceptance testing participation	Sacramento, California	Oct. 14 to 15	Murphy	S&ID, Aerojet
Design interface working group meeting	Bethpage, L.I., New York	Oct. 14 to 16	Gustavson, Neatherlin	S&ID, Grumman
Program status briefing	Sacramento, California	Oct. 14 to 16	Barker	S&ID, Aerojet
Block II communication system design changes, meeting	Houston, Texas	Oct. 14 to 16	Tyner	S&ID, NASA
Engineering review meeting	Minneapolis, Minnesota	Oct. 14 to 16	Barnett, Bennett, Peterson	S&ID, Honeywell
Design requirements coordination meeting	Minneapolis, Minnesota	Oct. 14 to 16	Gilman	S&ID, Honeywell
Service propulsion engine qualification design review	Sacramento, California	Oct. 14 to 16	Cadwell, Colston, Simkin, Koppang, Dupaquier	S&ID, Aerojet
Engineering coordination meeting	Houston, Texas	Oct. 14 to 16	Heaton	S&ID, NASA
Specification and test procedure coordination	Minneapolis, Minnesota	Oct. 14 to 22	Hunt	S&ID, Rosemount
Gimbal system design review meeting	Sacramento, California	Oct. 15 to 16	Tutt, Jansen	S&ID, Aerojet
Subcontractor performance evaluation	Rolling Meadows, Illinois	Oct. 15 to 17	Cason	S&ID, General Time
Boilerplate 23 design engineering inspection	Las Cruces, New Mexico	Oct. 15 to 16	Bajkowski	S&ID, NASA

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